99911220 生化分离工程 Bioseparation Engineering

1. **课堂讲授学时 Lecture Hours 32**
2. **课堂实验学时 Laboratory Hours 0**
3. **课下研讨学时 Colloquia Hours 6**
4. **学生课下投入学时 Individual Study Hours 32**
5. **学分 Credits 2**
6. **开课学年学期（如果有强制性的要求则必须填，否则可以不填）Occurrence：1st year, 2nd year, 3rd year, 4th year; Autumn, Spring**
7. **先修课程 Prerequisite(s): 必须先修的课程直接写课程编号和课程名称，建议先修的课程在课程名称后用*号标注，并在下一行注明：*Recommended, not required as prerequisite**

   1000066 计算机辅助药物分子设计；*Recommended, not required as prerequisite

   1000069 生化制药工程；*Recommended, not required as prerequisite

   1000064 合成制药技术前沿；*Recommended, not required as prerequisite

   1000204 人工智能药物；*Recommended, not required as prerequisite
8. **课程概要 Course Description:** 本课程主要讲述生物大分子, 包括生物技术产品，的分离、提取、分析方法及其技术原理。具体内容有分为两部分：第一部分主要讲述生物体系的性质；组织和细胞的破碎；生物大分子沉淀；离心；吸附；柱层析；过滤和膜分离等技术方法的原理和应用。第二部分通过实例具体讲述从不同生物组织中分离具有不同生物活性的分子。
9. **课程预期学习成果 Course Outcomes:**

   1. 学习生物大分子的分类与特性：课程将介绍生物大分子的不同类别，如蛋白质、核酸、多糖等的特性和结构，让学生了解它们在生物体内的功能和作用。

   2. 掌握生物大分子的提取与分离方法：学生将学习各种生物大分子的提取和分离方法，包括但不限于离心、柱层析、电泳、超滤等技术，以及这些方法的原理和适用范围。

   3. 理解生物大分子的技术原理：课程将深入探讨生物大分子提取与分离的原理，包括各种技术背后的化学、物理和生物学基础，让学生理解这些方法的工作机制。

   4. 熟悉动植物组织细胞中生物大分子的提取方法：学生将学会从动植物组织或细胞中提取生物大分子的基本方法，涵盖了细胞破碎、溶解、离心等步骤，以及针对不同生物大分子的特殊处理技术。

   5. 掌握生物大分子分析技术：学生将学习如何运用分光光度计、电泳仪、质谱仪等分析工具对提取的生物大分子进行定量和定性分析，以及数据的解读和分析方法。

   6. 培养解决生产问题的能力：通过案例分析和实践操作，学生将掌握分析和解决实际生产中遇到的生物大分子相关问题的能力，培养他们的实践操作技能和解决问题的思维能力。

   7. 加强理论与实践相结合的学习方式：课程将理论知识与实际操作相结合，通过实验室实践让学生亲自操作并观察生物大分子的提取和分离过程，从而更深入地理解课程内容。

   8. 建立专业工作的理论和操作基础：通过学习本课程，学生将建立起处理生物大分子的理论知识和实践技能，为未来从事相关专业工作打下坚实的基础，如生物技术、医药研发、生物制药等领域。

   9. 提高对生物大分子应用的认识：除了提取和分离技术，课程还将介绍生物大分子在生

物技术产品制备、药物研发、基因工程等领域的应用，让学生了解生物大分子在现代生物科学和工程中的重要性和广泛应用。

10. 教学内容与学时分配 Course Content, Laboratories and Laboratory Hours（有则填，没有则不填）, Colloquia Hours（有则填，没有则不填）:

1. 生物分离工程简介 2 学时

介绍生物工程和生物分离的目的以及重要性；生物分离的基本原理和技术方法。

2. 生物体系的性质 2 学时

讲述各种生物体系，生物大分子的性质，包括分子大小分子结构以及功能与结构的关系。

3. 常用的生物分离技术 2 学时

包括组织破碎，沉淀，萃取，吸附，离心

4. 层析 3 学时

讲述层析分离体系及分离原理， 包括各种层析介质，系统和不同的方法

5. 由动物/人组织提取，纯化生物活性酶和蛋白质 - 设计，过程和分析结果 4 学时

5.1 通过具体实例讲述如何从动物组织分离活性酶

5.2 从人血浆分离蛋白质

6. 重组蛋白质的生产，分离和质量控制- 讲述生产医用蛋白质，包括抗体药物的制备，生产，分离，质量控制 4 学时

6.1 胰岛素

6.2 抗体

7. 由动物组织提取，纯化生物活性多糖 - 通过具体实例讲述分离过程和分析结果以及临床应用 4 学时

7.1 由猪小肠分离纯化肝素以及活性鉴定

7.2 由牛软骨提取硫酸软骨素

8. 从植物中分离天然有生物活性的大分子 3 学时

讲述由天然植物中分离有生物活性的大分子：分离原理和潜在的前景。

9. 课堂讨论与汇报 8 学时

11. 考核与成绩评定 Grading:

成绩以百分制衡量。
作业成绩：40%；
专题讨论：30%；
团队展示：30%。

12. **教材，参考书 Text & Reference Book:** 作者，书名，版本，年份，国际标准书号 ISBN

Raja Ghosh，Principles of Bioseparations Engineering，1st ，2006，981-256-892-1

13. 编写教师 Course Lecturer：

李晋萍

编写教师 Course Lecturer（签字）：

附录：英文课程教学大纲模板

附录：

Syllabus for Bioseparation Engineering

1. 课堂讲授学时 Lecture Hours: 32
2. 课堂实验学时 Laboratory Hours: 0
3. 课下研讨学时 Colloquial Hours: 6
4. 学生课下投入学时 Individual Study Hours: 32
5. 学分 Credits: 2
6. 开课学年学期（如果有强制性的要求则 必须填，否则可以不填） Occurrence: Summer Course
7. 先修课程 Prerequisite(s):

   Programming-related courses* (*Recommended, not required as prerequisite)

8. 课程概要 Course Description: 100 字以内，学习内容以学术关键词出现。

   This course focuses on the separation, extraction, and analysis of biological macromolecules, including biotechnological products, along with their technical principles. The curriculum is divided into two parts: Part I covers the properties of biological systems and the principles and applications of key techniques such as tissue and cell disruption, precipitation, centrifugation, adsorption, column chromatography, filtration, and membrane separation. Part II provides case studies on the isolation of various bio-active molecules from diverse biological tissues.

9. 课程预期学习成果 Course Outcomes:

   By the end of successful completion of this course, the student will be able to:

   1. Classify and Characterize Biomacromolecules: Explore the structural properties and biological functions of key macromolecules, including proteins, nucleic acids, and polysaccharides.

   2. Master Extraction and Separation Methodologies: Gain proficiency in core techniques such as centrifugation, column chromatography, electrophoresis, and ultrafiltration, including their operational principles and applicable scopes.

3. Grasp Fundamental Technical Principles: Delve into the chemical, physical, and biological mechanisms underlying various separation technologies to understand their working logic.

4. Execute Tissue and Cell Processing: Acquire hands-on skills in isolating biomolecules from plant and animal sources, covering cell disruption (lysis), solubilization, and specialized purification protocols.

5. Utilize Analytical Instrumentation: Perform qualitative and quantitative assessments using spectrophotometry, electrophoresis, and mass spectrometry, while mastering data interpretation and analytical modeling.

6. Enhance Industrial Problem-Solving Abilities: Apply theoretical knowledge to resolve real-world production challenges through case studies, fostering critical thinking and practical troubleshooting skills.

7. Integrate Theory with Laboratory Practice: Deepen comprehension through direct observation and hands-on execution of extraction and separation workflows in a lab setting.

8. Build a Professional Foundation for Bio-Industries: Establish the essential theoretical and practical framework required for careers in biotechnology, pharmaceutical R&D, and biomanufacturing.

9. Broaden Perspectives on Practical Applications: Recognize the pivotal role of biomacromolecules in genetic engineering, drug discovery, and the development of high-value biotech products.

10. 教学内容与学时分配 Course Content, Laboratories and Laboratory Hours（有则填，没有则不填），Colloquial Hours（有则填， 没有则不填）；

Unit 1 · Introduction to Bioseparation Engineering (2 Class Hours)

The objectives and significance of bioseparation in bioengineering. Basic principles and common technical methods of biological separation.

Unit 2 · Properties of Biological Systems (2 Class Hours)

Analysis of various biological systems and the properties of biomacromolecules, including molecular size, structural integrity, and the relationship between structure and biological function.

Unit 3 · Essential Bioseparation Techniques (2 Class Hours)

Fundamental methods including tissue disruption, precipitation, extraction, adsorption, and centrifugation.

Unit 4 · Chromatography: Principles and Systems (3 Class Hours)

Principles of chromatographic separation systems. Types of chromatographic media, instrumentation, and specialized methodologies.

Unit 5 · Protein and Enzyme Purification from Animal/Human Tissues: Design, Process, and Analysis (4 Class Hours)

5.1 Isolation of active enzymes from animal tissues (case study).

5.2 Separation of proteins from human plasma.

Unit 6 · Production, Separation, and Quality Control of Recombinant Proteins: Therapeutic Proteins Including Antibodies (4 Class Hours)

6.1 Insulin: production and purification processes.

6.2 Antibodies: manufacturing, separation, and quality control.

Unit 7 · Bioactive Polysaccharides from Animal Tissues: Separation, Analysis, and Clinical Applications (4 Class Hours)

7.1 Purification of heparin from porcine small intestine and activity assay.

7.2 Extraction of chondroitin sulfate from bovine cartilage.

Unit 8 · Plant-Derived Bioactive Macromolecules (3 Class Hours)

Isolation of naturally occurring bioactive macromolecules from plants: principles, methods, and potential applications.

Unit 9 · Interactive Discussions and Presentations (8 Class Hours)

Student-led presentations, case discussions, and group reports to consolidate course knowledge.

11. 考核与成绩评定 Grading:

Final grades are based on a 100-point scale:

Assignments: 40%

Seminar Discussions: 30%

Team Presentations: 30%

12. 教材，参考书 Text & Reference Book:

Raja Ghosh，Principles of Bioseparations Engineering，1st ，2006，981-256-892-1

13. 编写教师 Course Lecturer:

Jinping Li

编写教师 Course Lecturer（签字）：